WHAT IS CLAIMED IS:

1. A payload isolation system for isolating a payload from a base structure upon which the payload is supported, the payload isolation system comprising:

motion constraint means for maintaining a parallel relationship between the payload and the base structure; and

support means for providing vertical and/or lateral support of the payload relative to the base structure such that the transmission of vertical and/or lateral vibration between the payload and the base structure are suppressed.

2. The payload isolation system of claim 1, wherein the motion constraint means comprises a mechanical linkage.

3. The payload isolation system of claim 2, wherein the mechanical linkage comprises at least one parallelogram linkage disposed between the payload and base structure.

4. The payload isolation system of claim 3, wherein each of the at least one parallelogram linkage comprises first and second parallelogram sub-linkages, the first and second parallelogram sub-linkages sharing a common member, one of the first or second parallelogram sub-linkages being fixed to the payload or a portion thereof, the other of the first or second parallelogram sub-linkages being fixed to the base structure or a portion thereof.

5. The payload isolation system of claim 4, wherein the at least one parallelogram linkage comprises two or more parallelogram linkages wherein at least two of the parallelogram linkages are configured non-parallel to each other.

6. The payload isolation system of claim 1, wherein at least a portion of the vertical and/or lateral support is provided by actuators arranged to apply a vertical and/or lateral force against the payload.

7. The payload isolation system of claim 1, further comprising damping means for resisting relative displacement and/or velocity between the payload and base structure.

8. The payload isolation system of claim 2, wherein the mechanical linkage comprises at least one scissor linkage each having first and second scissor sub-linkages disposed between the payload and base structure, the first and second scissor sub-linkages being connected to each other by first and second common members, a first end of each of the first and second scissor sub-linkages being fixed to the payload or a portion thereof and a second end of the first and second scissor sub-linkages being fixed to the base structure or a portion thereof.

9. The payload isolation system of claim 8, wherein the at least one scissor linkage comprises two or more scissor linkages,

at least two of the parallelogram linkages being configured non-parallel to each other.

10. The payload isolation system of claim 8, wherein the support means comprises a spring means and a linear actuator means in series disposed on one of the first or second common members.

11. The payload isolation system of claim 8, wherein the support means comprises an elastic means for biasing the first and second common members together.

12. The payload isolation system of claim 1, wherein the support means provides one of vertical or lateral support of the payload relative to the base structure.

13. The payload isolation system of claim 1, wherein the support means provides both vertical and lateral support of the payload relative to the base structure.

14. The payload isolation system of claim 1, wherein the support means comprises a deformable mat having at least one internal tubular cavity such that the deformable mat exhibits nonlinear elastic characteristics in response to an effective weight of the payload.

15. The payload isolation system of claim 14, wherein the non-linear elastic characteristics comprise a substantially rigid characteristic at low and high levels of deformation and a compliant characteristic at intermediate levels of deformation.

16. The payload isolation system of claim 14, wherein the at least one internal tubular cavity comprises a plurality of internal tubular cavities interconnected to each other such that the plurality of internal tubular cavities act as a single cavity.

17. The payload isolation system of claim 1, wherein the support means comprises a bottom plate fixed to one of the payload or base structure or portions thereof, a top plate movable relative to the bottom plate and fixed to the other of the payload or base structure or portions thereof, the support means further comprising a compressible material disposed in a space between the top and bottom plates.

18. The payload isolation system of claim 17, wherein the space between the top and bottom plates defines an annular cavity and wherein the compressible material disposed in the space is an elastomeric extruded tubular element, the elastomeric extruded tubular element having a tubular cavity running therethrough and being coiled within the space in a helical manner to thereby fill the space.

19. The payload isolation system of claim 1, further comprising a payload adjustment means for adjusting the level of support of the support means in response to a variation in an effective payload weight, and/or a variation in a relative distance between the payload and the base structure.

20. The payload isolation system of claim 19, wherein the payload adjustment means comprises:

support adjustment means for adjusting the level of support of the support means; and

a feedback means for sensing a change in relative distance between the payload and the base structure and controlling the support adjustment means in response thereto.

21. The payload isolation system of claim 20, wherein the support adjustment means comprises:

a deformable mat having at least one internal tubular cavity; and

a gas source in communication with the at least one internal cavity;

wherein the feedback means controls the gas pressure level in the internal tubular cavity in response to the change in relative distance between the payload and the base structure.

22. The payload isolation system of claim 20, wherein the support adjustment means comprises:

a bottom plate fixed to one of the payload or base structure or portions thereof;

a top plate movable relative to the bottom plate and fixed to the other of the payload or base structure or portions thereof;

an elastomeric extruded tubular element disposed in an annular cavity defined between the top and bottom plates, the elastomeric extruded tubular element having a tubular cavity running therein and being coiled within the space in a helical manner to thereby fill the space; and

a gas source in communication with the tubular cavity;

wherein the feedback means controls the gas pressure level in the tubular cavity in response to the change in relative distance between the payload and the base structure.

23. The payload isolation system of claim 20, wherein the support adjustment means comprises:

a deformable mat having at least one internal tubular cavity; and

a ramp means for engaging the deformable mat to vary an amount of surface area in contact with the payload; and

drive means for driving the ramp means between locations in which more or less surface area is in contact with the payload;

wherein the feedback means controls the drive means to change the amount of surface area in contact with the payload.

24. The payload isolation system of claim 20, wherein the feedback means comprises:

distance signal generation means for generating a distance signal proportionate to the sensed relative distance between the payload and the base structure;

a first low pass filter for converting the distance signal into a slowly varying signal representing average position along with a small high frequency ripple component;

a summer for subtracting a reference signal from the slowly varying signal to provide an output error signal;

a gain means for outputting a signal indicative of vibrational peaks from an input of the error signal;

a second low pass filter for averaging the vibrational peaks signal into a final error signal; and

a throttling transducer means for responding to the final error signal which is input to the support adjustment means thereby more efficiently controlling the support adjustment means and reducing vibrational chattering of the support adjustment means.

25. The payload isolation system of claim 1, wherein the payload and base structure are components of a rocket and wherein the effective weight of the payload varies with time.

26. The payload isolation system of claim 1, wherein the support means comprises one or more of the following:

a deformable mat having at least one internal tubular cavity such that the deformable mat exhibits nonlinear elastic characteristics in response to an effective weight of the payload;

at least one first motor disposed between the payload and base structure for providing vertical support of the payload, the at least one first motor being under the control of a control means in response to detected vertical disturbances of the payload relative to the base structure; and

at least two second motors disposed between the payload and base structure for providing lateral support of the payload, the at least two second motors being under the control of a control means in response to detected lateral disturbances of the payload relative to the base structure.

27. A motion constraint mechanism comprising:

a first mechanical linkage disposed between a payload and a base structure; and

at least a second mechanical linkage arranged relative to the first mechanical linkage such that the first and at least second mechanical linkages maintain a parallel relationship between the payload and the base structure.

28. The motion constraint mechanism of claim 27, wherein at least one of the first or at least second mechanical linkages comprises a parallelogram linkage disposed between the payload and base structure.

29. The motion constraint mechanism of claim 28, wherein each of the parallelogram linkages comprises first and second parallelogram sub-linkages, the first and second parallelogram sub-linkages sharing a common member, one of the first or second parallelogram sub-linkages being fixed to the payload or a portion thereof, the other of the first or second parallelogram sub-linkages being fixed to the base structure or a portion thereof.

30. The motion constraint mechanism of claim 27, wherein the first and at least second mechanical linkages are arranged non-parallel to each other.

31. The motion constraint mechanism of claim 27, wherein at least one of the first or at least second mechanical linkages comprises a scissor linkage having first and second scissor sub-linkages disposed between the payload and base structure, the first and second scissor sub-linkages being connected to each other by first and second common members, a first end of each of the first and second scissor sub-linkages being fixed to the payload or a portion thereof and a second end of the first and second scissor sub-linkages being fixed to the base structure or a portion thereof.

32. The motion constraint mechanism of claim 31, further comprising support means for providing vertical and/or lateral support of the payload relative to the base structure such that

the transmission of vertical and/or lateral vibration between the payload and the base structure are suppressed.

33. The motion constraint mechanism of claim 31, wherein the support means comprises a spring means and a linear actuator means in series disposed on one of the first or second common members.

34. The motion constraint mechanism of claim 31, wherein the support means comprises an elastic means for biasing the first and second common members together.

35. The motion constraint mechanism of claim 27, further comprising support means for providing vertical and/or lateral support of the payload relative to the base structure such that the transmission of vertical and/or lateral vibration between the payload and the base structure are suppressed.

36. A method for constraining motion between a payload and a base structure, the method comprising the steps of:

providing a first mechanical linkage disposed between the payload and the base structure;

providing at least a second mechanical linkage disposed between the payload and the base structure; and

arranging the first and at least second mechanical linkages relative to each other such that the first and at least

second mechanical linkages maintain a parallel relationship between the payload and the base structure.

37. The method of claim 36, wherein the arranging step comprises configuring the first and second mechanical linkages non-parallel to each other.

38. The method of claim 36, further comprising the step of providing vertical and/or lateral support of the payload relative to the base structure such that the transmission of vertical and/or lateral vibration between the payload and the base structure are suppressed.

39. A support apparatus for providing vertical and/or lateral support of a payload relative to the base structure such that the transmission of vertical and/or lateral vibration between the payload and the base structure are suppressed, the support apparatus comprising:

a deformable member exhibiting nonlinear elastic characteristics in response to an effective payload weight;

support adjustment means for supporting the effective payload weight; and

effective payload adjustment means for adjusting the level of support of the support means in response to a varying effective payload weight.

40. The support apparatus of claim 39, wherein the deformable member further having at least one internal tubular cavity.

41. The support apparatus of claim 39, wherein the non-linear elastic characteristics comprise a substantially rigid characteristic at low and high levels of deformation and a compliant characteristic at intermediate levels of deformation.

42. The support apparatus of claim 40, wherein the deformable member comprises a deformable mat and the at least one internal tubular cavity comprises a plurality of internal tubular cavities.

43. The support apparatus of claim 42, wherein the plurality of internal tubular cavities are interconnected to each other such that the plurality of internal tubular cavities act as a single cavity.

44. The support apparatus of claim 39, wherein the deformable member comprises a bottom plate fixed to one of the payload or base structure or portions thereof, a top plate movable relative to the bottom plate and fixed to the other of the payload or base structure or portions thereof, the deformable member further comprising a compressible material disposed in a space between the top and bottom plates.

45. The support apparatus of claim 44, wherein the space between the top and bottom plates defines an annular cavity and wherein the compressible material disposed in the space is an elastomeric extruded tubular element, the elastomeric extruded tubular element having a tubular cavity running therein and being coiled within the space in a helical manner to thereby fill the space.

46. The support apparatus of claim 39, wherein the effective payload adjustment means comprises feedback means for sensing a change in relative distance between the payload and the base structure and controlling the support adjustment means in response thereto.

47. The support apparatus of claim 46, wherein the support adjustment means comprises a gas source in communication with the at least one internal cavity wherein the feedback means controls the gas pressure level in the internal tubular cavity in response to the change in relative distance between the payload and the base structure.

48. The support apparatus of claim 46, wherein the deformable member comprises a deformable mat and wherein the support adjustment means comprises:

a ramp means for engaging the deformable mat to vary an amount of surface area in contact with the payload; and

drive means for driving the ramp means between locations having more or less surface area in contact with the payload;

wherein the feedback means controls the drive means to change the amount of surface area in contact with the payload.

49. The support apparatus of claim 46, wherein the feedback means comprises:

distance signal generation means for generating a distance signal proportionate to the sensed relative distance between the payload and the base structure;

a first low pass filter for converting the distance signal into a slowly varying signal representing average position along with a small high frequency ripple component;

a summer for subtracting a reference signal from the slowly varying signal to provide an output error signal;

a gain means for outputting a signal indicative of vibrational peaks from the input of the error signal;

a second low pass filter for averaging the vibrational peaks signal into a final error signal; and

a throttling transducer means for responding to the final error signal which is input to the support adjustment means thereby more efficiently controlling the support adjustment means and reducing vibrational chattering of the support adjustment means.